ARS 44-176
May 1966

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

THE VALUE OF MATURE CORN FOR SILAGE

by C. H. Gordon, 1/ J. C. Derbyshire 1/ and J. L. Humphrey 2/

In the past, recommended harvest dates for corn silage have been influenced considerably by the possibility that silage would spoil and that the feeding value would be lowered if maturity progressed much beyond 30-percent dry matter in the whole plant. This maturity stage has also been described as the early dent to soft dough stage. Because later harvest dates might be advantageous to work schedules and to the availability of silo space, these experiments were conducted to determine the effect on feeding value and cost in terms of nutrient loss of delaying harvest beyond full plant maturity.

PROCEDURE

1964 Crop

A 20-acre field of corn (Funk, G-134) was divided into 17 plots of 8 rows each. Eight of these plots were harvested on September 21 and 22, 1964, at a hard dough stage and the corn stored in a Harvestore silo. 3/ Yields were low because of drought conditions, although crop moisture content was affected by 1.4 inches of rain that occurred September 19.

The other nine plots were harvested November 9, at which time the plants were mature and had been frozen several times. Harvesting and storage procedures for all plots were the same except for the application of water

- - - - - - - - - - - - - - -

1/ Dairy Husbandmen, Animal Husbandry Research Division, Agricultural Research Service.

2/ Agricultural Technician, Animal Husbandry Research Division, Agricultural Research Service.

3/ Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty and does not signify that the product is approved to the exclusion of other comparable products.

at the blower to corn obtained from the later harvest. A 3/4-inch hose, opened when the blower was operating, applied water at an estimated rate of 170 pounds per ton of forage.

The yield from each plot was determined by area measurement and by weighing and sampling each load for the determination of dry matter. Samples of corn were frozen and later composited on a plot basis for the determination of crude protein, acid detergent fiber, and lignin. Silos were opened December 8 and the silage was evaluated in two feeding trials with milking dairy cows and in a digestibility trial with sheep.

FEEDING TRIALS

The relative intake potential of the silages was tested in trial 1 with 14 cows assigned to 7 outcome groups on the basis of previously observed levels of corn silage consumption. One cow in each group was randomly assigned to normal or late harvested corn silage fed ad libitum. The remainder of the rations consisted of U.S. No. 1 alfalfa hay (0.5 percent of live weight), a mineral mixture (free choice), and a 16 percent crude protein grain mixture (according to individual milk production, Morrison's intermediate level). These rations were fed a total of 50 days in which the first 10 days were regarded as an adjustment period. Grain was uniformly reduced 10 percent after 30 days.

After the completion of trial 1, all cows were fed normal corn silage for 30 days and were then reassigned to 7 outcome groups on the basis of milk production level for trial 2. After random assignment to one of the silages, silage feeding was controlled to obtain equal dry matter intakes from both silages within a cow pair. Otherwise the design and length of trial 1 were identical to those of trial 2.

DIGESTIBILITY TRIAL

Digestibility of the silages as the sole ration for 6 wether sheep was determined in a total collection, switch back trial. Each period consisted of 10 days preliminary and 7 to 8 days collection. Silage was fed once daily at levels calculated to eliminate refusals. Silage was sampled daily and composite samples were analyzed for the constituents reported.

1965 Crop

Funk, G7-11AA corn was harvested on September 8 and 9 and November 8, 1965. Yields were determined on six alternating areas on each date. Storage, weighing, sampling, and analyses of harvested forage were conducted as described for the 1964 crop. Forage yields were higher than in 1964, although severe winds had occurred several days before the first harvest. Investigation of the feeding value of these silages is now underway.

RESULTS

Average fresh weight and dry matter yields are shown in table 1. A between and within silage analysis of variance was computed to detect differences between silages for each variable in each year.

TABLE 1. -- Forage Yields

Harvest	Yield per acre			
	Fresh Weight	Dry Weight	Dry Matter	Dry Matter Lost
	lb.	lb.	Pct.	Pct.
1964:				
Normal- - - - - - - - - -	20,126**	5,301**	26.3**	--
Late- - - - - - - - - - -	7,386**	4,309**	58.3**	18.7
Standard deviation- -(s)-	875	218	1.8	--
1965:				
Normal- - - - - - - - - -	30,557**	9,918**	32.4**	--
Late- - - - - - - - - - -	12,073**	7,229**	60.0**	27.2
Standard deviation- -(s)-	895	510	1.9	--

** Mean difference is statistically significant when $P = < 0.01$.

A marked reduction in fresh weight and increase in dry matter percentage was observed in both years as a result of delaying the harvest. These changes were expected and are explained on the basis of maturation of the plant. However, the most striking effect was the lower dry matter yield from the late harvested plots. Yields were reduced most in 1965. The greater loss could be associated with the initially higher yield, or the wind damage of that year, or both.

Delayed harvest resulted in increased dry matter content but in no significant changes in crude protein and lignin in both years (table 2). Acid detergent fiber increased with delayed harvesting in 1964 but not in 1965. Differences in changes of grain to forage ratios because of weather and varietal differences may have accounted for this inconsistency, but no data are available to clarify this point.

TABLE 2. -- Average analysis of silage stored and fed

Harvest	Average analyses - percent			
	Dry Matter	Crude Protein	Acid detergent fiber	Lignin
Forage stored 1964:				
Normal- - - - - - - - - -	26.3**	9.1	25.3**	2.9
Late- - - - - - - - - - -	58.2**	9.2	29.4**	3.2
Standard deviation- -(s)-	1.70	.29	1.71	.42
Silage fed 1964:				
Normal- - - - - - - - - -	27.6**	9.2	26.1**	2.8
Late- - - - - - - - - - -	55.3**	9.6	23.8**	3.0
Standard deviation- -(s)-	3.38	.74	.65	.57
Forage stored 1965:				
Normal- - - - - - - - - -	32.4**	7.7	27.0	4.2
Late- - - - - - - - - - -	60.0**	7.8	25.9	4.0
Standard deviation- -(s)-	1.73	.26	1.11	.50

** Mean difference is statistically significant when P = < 0.01.

The water added at the blower when storing 1964 late-harvested silage resulted in only a minor change in dry matter content (table 2). The method of adding water was fairly convenient, but the value of the practice was not determined.

The apparent decrease in percent acid detergent fiber during storage of the 1964 late harvested silage is puzzling. Quantitative recovery calculations show a much greater disappearance of acid detergent fiber than of total dry matter. This could be explained by conversion of cellulose, or hemicellulose, or both, to a simpler form of dry matter during storage. Much more data are needed before any such explanation could be accepted.

Significant differences in the chemical quality of 1964 crop silages were observed (table 3), although both silages were considered to be good quality. More extensive fermentation in the normal, higher moisture

silage was indicated by the lower pH and higher acid content. The lower residual sugar in the late-harvested silage may have been associated with more sugar-to-starch conversion prior to storage. Unfortunately, stored forage was not analyzed for sugar.

TABLE 3. -- Average chemical quality of 1964 silage as fed

	pH	Ammoniacal nitrogen 1/	Butyric acid 2/	Propionic acid 2/	Acetic acid 2/	Sugar 2/
Normal- - - - - - -	3.63**	7.50	0.2	0.2	1.7**	3.5*
Late- - - - - - - -	3.96**	7.81	0.1	0	0.8**	3.3*
Standard deviation(s)	0.12	1.72	0.3	0.4	0.4	1.0

** and * mean differences are statistically significant at the 1-percent and 5-percent levels of probability, respectively.
1/ Stated as percent of total nitrogen.
2/ Stated as percent of dry matter.

Average values from the feeding trials are shown in table 4. The significance of differences among silages in corn silage consumed, fat corrected milk (4-percent FCM) produced, FCM regression, and daily live weight changes were tested by an analysis of variance. None of the differences were significant at the 5-percent level of probability.

Ad libitum consumption of the 1964 normal date silages was slightly greater than of the late-harvested silages. The grain levels employed were probably too high to achieve high forage intakes on either ration. However, grain levels were similar to those commonly employed for high production levels, and the similarity of the feeding value of these silages as judged by intake, milk production on weight gains should be applicable to these situations.

TABLE 4. -- Summary of feeding trials - 1964 crop

Item	Trial 1 Silage		Trial 2 Silage	
	Normal	Late	Normal	Late
Number of Cows- - - - - - - - - -	7	7	7	7
Daily dry matter consumption, as percent of liveweight:				
Corn Silage- - - - - - - - -	1.54	1.44	1.36	1.42
Concentrates - - - - - - - - -	1.37	1.31	1.34	1.36
Hay- - - - - - - - - - - - - -	.33	.37	.32	.34
Total- - - - - -	3.24	3.12	3.02	3.12
4% fat corrected milk, lb/day - -	51.1	50.0	49.5	47.3
4% fat corrected milk regression, lb/day - - - - - - - - - - - - -	-.16	-.22	-.02	-.06
Liveweight, lb. - - - - - - - - -	1168	1162	1259	1286
Daily liveweight change, lb.- - -	+.89	+.77	+.86	+.59

The results of trial 2 (controlled equalized intake) were similar to those of trial 1 because the uncontrolled intakes were also nearly equal. Some difficulty was experienced with all rations in obtaining full hay consumption of the small hay ration offered. This appeared to be an individual cow characteristic.

The digestibility, for sheep, of the dry matter of the normal silage was somewhat higher than that of late-harvested silage. The digestibility of normal silage was 70.3 percent; that for late-harvested 68.8 percent ($P = < .05$). Digestibility of acid detergent fiber in normal silage was 63.1 percent; that for late-harvested, 60.1 percent ($P = < .01$). Digestibility of crude protein was not significantly different for the two kinds of silages - 57.2 and 55.6 percent, respectively. Absolute and relative efficiency of digestion in the cows, however, may have differed from those obtained with sheep, because of differences in chewing habits. The kernels in late-harvested silage were noticably harder and appeared more frequently in the cow feces than did those in feces from normal silage. Cows will be utilized to determine the digestibility of 1965 silages.

Results to date seem to preclude adoption of delayed harvesting as a general practice because of large field losses. However, the quite satisfactory levels of preservation (in excellent silos) and of dairy cow utilization would justify delayed harvesting when it is unavoidable.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Beltsville, Maryland 20705

Official Business

Postage and Fees Paid
U. S. Department of Agriculture